# 5.0 TECHNICAL APPROACH

This section presents the technical approach used to estimate the current and allowable loads of fecal coliform and *E. coli* in the Kankakee/Iroquois watershed.

## 5.1 Load Duration Curves

The load duration curve calculates the allowable loadings of a pollutant at different flow regimes by multiplying each flow by the TMDL target value and an appropriate conversion factor. The following steps are taken:

1) A flow duration curve for the stream is developed by generating a flow frequency table and plotting the observed flows in order from highest (left portion of curve) to lowest (right portion of curve).

2) The flow curve is translated into a load duration (or TMDL) curve. To accomplish this, each flow value is multiplied by the TMDL target value and by a conversion factor and the resulting points are graphed. Conversion factors are used to convert the units of the target (e.g., #/100 mL) to loads (e.g., G-org/day) with the following factors used for this TMDL:

   a) Flow (cfs) x TMDL Concentration Target (#/100mL) x Conversion Factor (0.024463) = Load (G-org/day)

3) To estimate existing loads, each water quality sample is converted to a load by multiplying the water quality sample concentration by the average daily flow on the day the sample was collected and the appropriate conversion factor. Then, the existing individual loads are plotted on the TMDL graph with the curve.

4) Points plotting above the curve represent deviations from the water quality standard and the daily allowable load. Those points plotting below the curve represent compliance with standards and the daily allowable load.

5) The area beneath the load duration curve is interpreted as the loading capacity of the stream. The difference between this area and the area representing the current loading conditions is the load that must be reduced to meet water quality standards.

Water quality duration curves are created using the same steps as those used for load duration curves except that concentrations, rather than loads, are plotted on the vertical axis.

The stream flows displayed on water quality or load duration curves may be grouped into various flow regimes to aid with interpretation of the load duration curves. The flow regimes are typically divided into 10 groups, which can be further categorized into the following five "hydrologic zones" (USEPA, 2007):

- High flow zone: stream flows that plot in the 0 to 10-percentile range, related to flood flows.
- Moist zone: flows in the 10 to 40-percentile range, related to wet weather conditions.
- Mid-range zone: flows in the 40 to 50 percentile range, median stream flow conditions;
- Dry zone: flows in the 60 to 90-percentile range, related to dry weather flows.
- Low flow zone: flows in the 90 to 100-percentile range, related to drought conditions.

The duration curve approach helps to identify the issues surrounding the impairment and to roughly differentiate between sources. Table 57 summarizes the general relationship between the five hydrologic zones and potentially contributing source areas (the table is not specific to any individual pollutant). For example, the table indicates that impacts from wastewater treatment plants are usually most pronounced during dry and low flow zones because there is less water in the stream to dilute their loads. In contrast, impacts from channel bank erosion is most pronounced during high flow zones because these are the periods during which stream velocities are high enough to cause erosion to occur. Impacts from abandoned mining areas can occur during all flow zones.

The load duration curve approach also considers critical conditions and seasonal variation in the TMDL development as required by the Clean Water Act and EPA's implementing regulations. Because the approach establishes loads based on a representative flow regime, it considers seasonal variations and critical conditions attributed to flow conditions.

**Table 57. Relationship Between Load Duration Curve Zones and Contributing Bacteria Sources**

| Contributing Source Area | Duration Curve Zone | | | | |
|---|---|---|---|---|---|
| | High | Moist | Mid-Range | Dry | Low |
| Wastewater treatment plants | | | | M | H |
| Livestock direct access to streams | | | | M | H |
| Wildlife direct access to streams | | | | M | H |
| On-site wastewater systems/Unsewered Areas | M | M-H | H | H | H |
| Urban stormwater/CSOs | H | H | H | | |
| Agricultural runoff | H | H | M | | |
| Bacterial re-suspension from stream sediments | H | M | | | |
| Note: Potential relative importance of source area to contribute loads under given hydrologic condition (H: High; M: Medium; L: Low) | | | | | |

### 5.1.1 Stream Flow Estimates

Daily stream flows are necessary to implement the load duration curve approach. These were estimated using the observed flows available at a number of USGS gages in the Kankakee/Iroquois watershed. Most of the sampling sites were on small tributary streams whose flow patterns will vary widely from the active USGS gages which are primarily on larger rivers. To account for these differences historic gage data on smaller tributaries were used in addition to active gages. Table 58 outlines the USGS gages used to make flow estimates for each ungaged subwatershed outlet.

Flows were estimated based on drainage area weighting using the following equation:

$$Q_{ungaged} = \frac{A_{ungaged}}{A_{gaged}} \times Q_{gaged}$$

Where,

$Q_{ungaged}$: Flow at the ungaged location
$Q_{gaged}$: Flow at surrogate USGS gage station
$A_{ungaged}$: Drainage area of the ungaged location
$A_{gaged}$: Drainage area of the gaged location

In this procedure, the drainage area of each of the load duration stations was divided by the drainage area of the surrogate USGS gage. The flows for each of the stations were then calculated by multiplying the flows at the surrogate gage by the drainage area ratios. Additional flows were added to certain locations to account for wastewater treatment plants and CSOs that discharge upstream and are not directly accounted for using the drainage area weighting method.

**Table 58. USGS Site Assignments for Estimated Flows at Ungaged Sites**

| Watershed Group | HUC 10 | HUC 12 | Gage Assigned for Estimating Flows | Gage ID |
|---|---|---|---|---|
| Upper Kankakee | 107 | 10701 | Kankakee at Davis | 05515500 |
| | | 10702 | | |
| | | 10703 | | |
| | | 10704 | | |
| | | 10705 | | |
| | 104 | 10405 | Kankakee at Davis | 05515500 |
| | | 10407 | | |
| | | 10408 | | |
| | 102 | 10203 | Kankakee at Davis | 05515500 |
| | | 10204 | | |
| | | 10206 | | |
| | | 10208 | | |
| | | 10209 | | |
| | 101 | 10102 | Kankakee at Davis | 05515500 |
| | | 10103 | | |
| | | 10105 | | |
| | | 10106 | | |
| Upper Iroquois | 205 | 20502 | Sugar Creek at Milford | 05525500 |
| | | 20503 | | |
| | | 20505 | | |
| | | 20506 | | |
| | | 20508 | | |
| | 204 | 20401 | Iroquois River near Foresman | 05524500 |
| | | 20403 | | |
| | | 20404 | | |
| | | 20405 | | |
| | 203 | 20303 | Iroquois River at Rensselaer | 05522500 |
| | | 20304 | | |
| | | 20305 | | |
| | 202 | 20204 | Iroquois River near Foresman | 05524500 |
| | | 20205 | | |
| | | 20206 | | |
| | 201 | 20103 | Iroquois River at Rensselaer | 05522500 |
| Lower Iroquois | 206 | 20604 | Sugar Creek at Milford | 05525500 |
| | | 20605 | | |
| | | 20607 | | |
| | | 20608 | | |
| | | 20609 | | |
| | | 20610 | | |
| | 207 | 20702 | Sugar Creek at Milford | 05525500 |
| | | 20703 | | |
| | | 20704 | | |
| | | 20705 | | |
| | | 20706 | | |
| | | 20707 | | |
| | | 20711 | | |
| | 208 | 20808 | Iroquois at Iroquois, IL | 05525000 |
| Lower Iroquois | 209 | 20902 | Iroquois at Iroquois, IL | 05525000 |
| | 210 | 21001 | Iroquois at Iroquois, IL | 05525000 |
| | | 21002 | | |
| | 211 | 21102 | Iroquois at Iroquois, IL | 05525000 |
| | 212 | 21202 | Iroquois at Iroquois, IL | 05525000 |
| | 213 | 21302 | Iroquois at Iroquois, IL | 05525000 |
| | | 21303 | | |
| | | 21308 | | |
| | 214 | 21402 | Iroquois near Chebanse, IL | 05526000 |

**Table 58. USGS Site Assignments for Estimated Flows at Ungaged Sites**

| Watershed Group | HUC 10 | HUC 12 | Gage Assigned for Estimating Flows | Gage ID |
|---|---|---|---|---|
| Yellow | 106 | 10601 | Iroquois River at Rosebud | 05521000 |
| | | 10603 | | |
| | | 10604 | | |
| | 105 | 10501 | Yellow River at Plymouth | 05516500 |
| | | 10503 | | |
| | | 10504 | | |
| | | 10505 | | |
| | | 10506 | | |
| | 103 | 10302 | Yellow River at Plymouth | 05516500 |
| | | 10303 | | |
| | | 10305 | | |
| | | 10307 | | |
| | | 10309 | | |
| | | 10311 | | |
| | | 10312 | | |
| Middle Kankakee | 113 | 11302 | Singleton Ditch at Schneider | 05519000 |
| | | 11304 | | |
| | | 11305 | | |
| | | 11306 | | |
| | | 11307 | | |
| | | 11308 | | |
| | | 11310 | | |
| | | 11312 | | |
| | 112 | 11203 | Iroquois River at Rosebud | 05521000 |
| | | 11205 | | |
| | 111 | 11101 | Iroquois River at Rosebud | 05521000 |
| | | 11103 | | |
| | 110 | 11001 | Singleton Ditch at Schneider | 05519000 |
| | | 11005 | | |
| | | 11006 | | |
| | | 11007 | | |
| | | 11009 | | |
| | | 11010 | | |
| | 109 | 10902 | Iroquois River at Rosebud | 05521000 |
| | | 10904 | | |
| | 108 | 10802 | Iroquois River at Rosebud | 05521000 |
| | | 10805 | | |
| | | 10806 | | |
| | | 10807 | | |
| Lower Kankakee | 118 | 11806 | Kankakee River near Wilmington, IL | 05527500 |
| | | 11809 | | |

## 6.0 LINKAGE ANALYSIS

An essential component of developing a TMDL is establishing a relationship between the source loadings and the resulting water quality. Water quality data within the Kankakee/Iroquois watershed are discussed in Section 3.2 and potential point and nonpoint sources are inventoried in Section 4.0. The purpose of this section of the report is to evaluate which of the various potential sources is most likely to be contributing to the observed water quality impairments.

Establishing a linkage analysis for bacteria is challenging because there are so many potential sources and because bacteria counts have a high degree of variability. While it is difficult to perform a site-specific assessment of the causes of high bacteria for each location in the Kankakee/Iroquois watershed, it is reasonable to expect that general patterns and trends can be used to provide some perspective on the most significant sources.

Table 59 summarizes several of the potential bacteria sources in each subwatershed along with the *E. coli* data collected by IDEM in 2008. *E. coli* counts are highest in the Yellow River, Upper Iroquois, and Upper Kankakee subwatersheds which are all characterized by relatively high animal unit densities. It is therefore possible that waste generated by livestock in these subwatersheds is contributing to the elevated bacteria counts. In fact, the animal unit density of each subwatershed is strongly correlated with the geomean of *E. coli* counts in each subwatershed (Figure 25). Similar trends are not apparent with the other sources listed in Table 59. However, it is also possible that some other factor could explain the higher counts. For example, the Yellow River, Upper Iroquois, and Upper Kankakee are also headwater subwatersheds and many of the sampled tributaries therefore have a relatively small drainage area. Streams with smaller drainage areas generally have relatively higher *E. coli* counts because there is less opportunity for dilution compared to larger streams. Bacteria patterns associated with drainage areas, as well as flow conditions, are further discussed in the next several sections.

**Table 59. Potential sources of pathogens in the Kankakee/Iroquois Watershed.**

| | | Upper Kankakee | Middle Kankakee | Yellow River | Upper Iroquois | Lower Iroquois | Lower Kankakee |
|---|---|---|---|---|---|---|---|
| **Mean of All 2008 *E. coli* data (#/100mL)** | | 760 | 435 | 1014 | 767 | 473 | 514 |
| **Geomean of All 2008 E. coli data (#/100 mL)** | | 308 | 165 | 545 | 375 | 156 | 139 |
| **Source Type or Concern** | | | | | | | |
| Point | Total Average Design Flow of Wastewater Treatment Plants (MGD) | 10.8 | 10.4 | 8.6 | 2.6 | 3.1 | 31 |
| | Total Number of Combined Sewer Overflows | 0 | 1 | 23 | 9 | 16 | 2 |
| | Square Miles of MS4 Storm Water | 18.3 | 31.9 | 7.0 | 0 | 0.2 | 184.2 |
| Non-Point | Rural Population Density (persons/square mile) | 214 | 315 | 141 | 29 | 22 | 310 |
| | Animal Unit Density (units/square mile) | 146 | 65 | 329 | 185 | 53 | 37 |
| | Deer Density (animals/square mile) | 3 | 4 | 5 | 2 | 3 | 6 |

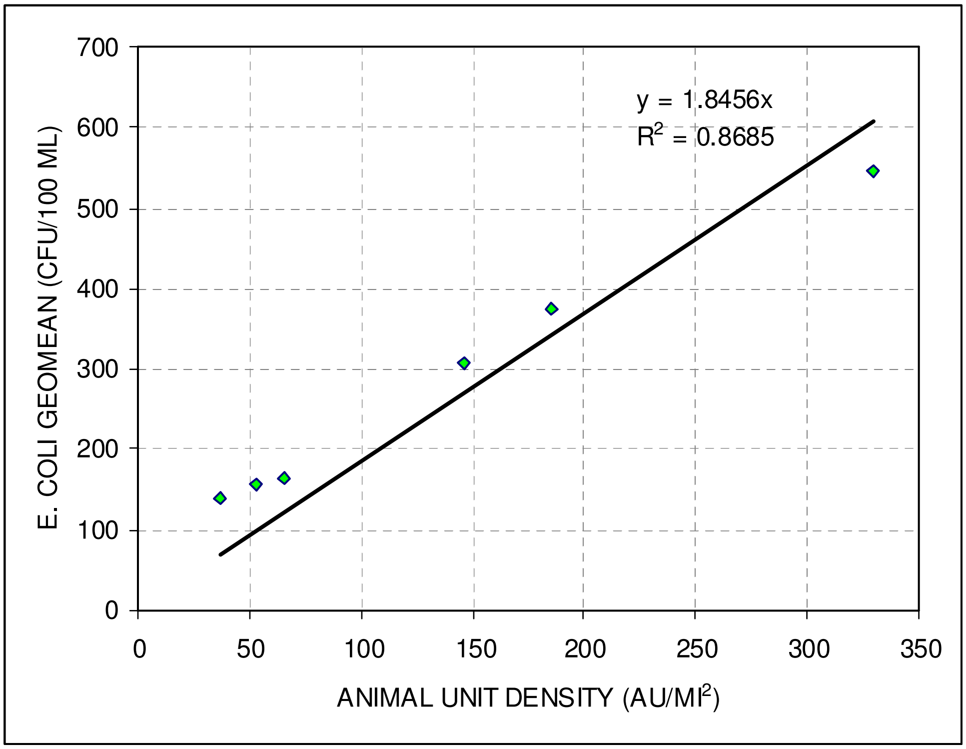



**Figure 25. Correlation of subwatershed animal unit densities and *E. coli* geomean (based on 2008 sampling data).**

## 6.1 Upper Kankakee

Data collected for the Upper Kankakee in the summer of 2008 indicate that there are *E. coli* exceedances throughout the subwatershed. In fact, only one site within the subwatershed did not exceed the geomean standard (Whitham Ditch, Station #35). The drainage area profile (Figure 26) does not show any definitive patterns within the subwatershed. Most of the 2008 IDEM water quality data were taken during moist and mid-range flow regimes; patterns might emerge if data were available for a wider range of flow conditions.

Figure 27 summarizes the 2008 bacteria data for the Upper Kankakee by tributary and indicates that the tributaries in general exhibit higher *E. coli* counts compared to the mainstem. Counts in the Potato/Pine tributaries are notably higher than in the Headwaters, Little Kankakee, Kingsbury/Robbins, and Upper Kankakee mainstem. A detailed assessment of the sources known to exist in the Potato and Pine Creek tributaries did not reveal any noticeable difference from other tributaries in the Upper Kankakee subwatershed, however.

Most facilities in this subwatershed are in compliance in with their flow and bacteria limits (Table 60).

**Table 60. Summary of NPDES facility compliance with design flow and bacteria permit limits in the Upper Kankakee subwatershed (2004 to 2006).**

| NPDES ID | Facility Name | Flow | | Bacteria | |
|---|---|---|---|---|---|
| | | Average Design Flow (MGD) | Number of Violations | Limit (#/100 mL) | Number of Violations |
| IN0023337 | Kingsford Heights Municipal WWTP | 0.422 | 0 | 125 | 1 |
| IN0025577 | La Porte Municipal STP | 7 | 0 | 125* | 6 |
| IN0025801 | North Liberty WWTP | 0.18 | 1 | 125 | 1 |
| IN0040100 | Hamlet Municipal STP | 0.1 | 3 | 125 | ND |
| IN0040690 | Walkerton Municipal WWTP | 0.364 | 2 | 125 | 0 |
| IN0045471 | Kingsbury Utility Corp | 2.5 | 0 | 125 | 11 |

Notes: MGD = Million gallons per day; ND= No data; *data at this facility also showed exceedances 235 standard

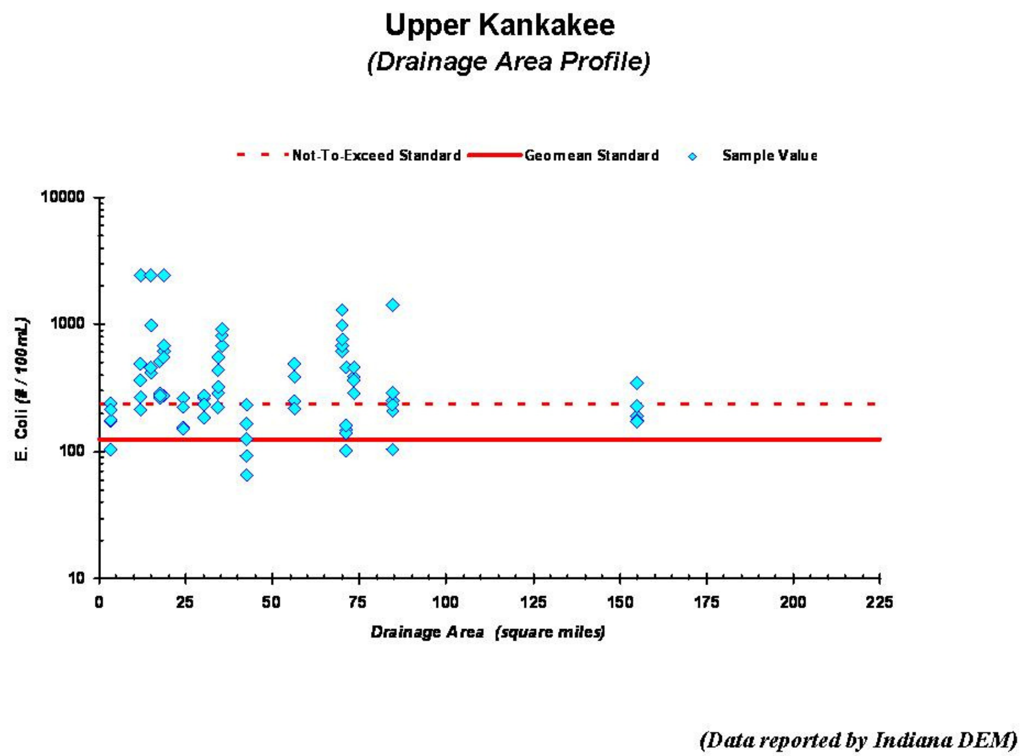



**Figure 26. Upper Kankakee Drainage Area Profile**

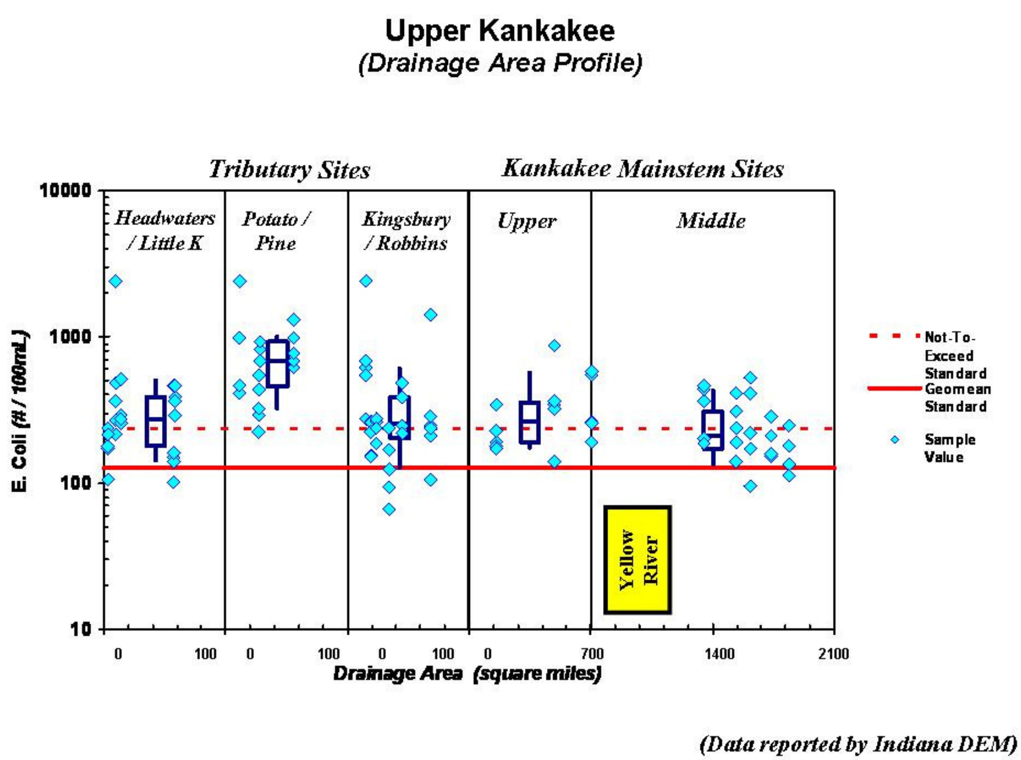



**Figure 27. Upper Kankakee Tributary versus Mainstem Drainage Area Profile**

An *E. coli* duration curve was prepared for sampling station KR-117 which is located on the Kankakee River in the Upper Kankakee subwatershed (Figure 29). Data are available at this station from 1988 to 1999 and the water quality duration curve is shown in Figure 28. The curve indicates that *E. coli* frequently exceeds 235 #/100 mL during high flows, moist conditions, and mid-range flows. The geomean of all the samples collected during low flows is less than 235 #/100 mL. Bacteria sources typically associated with high flow and moist conditions include failing onsite wastewater systems, urban stormwater/CSOs, runoff from agricultural areas, and bacterial re-suspension from the streambed.

**Kankakee River along Route 6, Indiana**

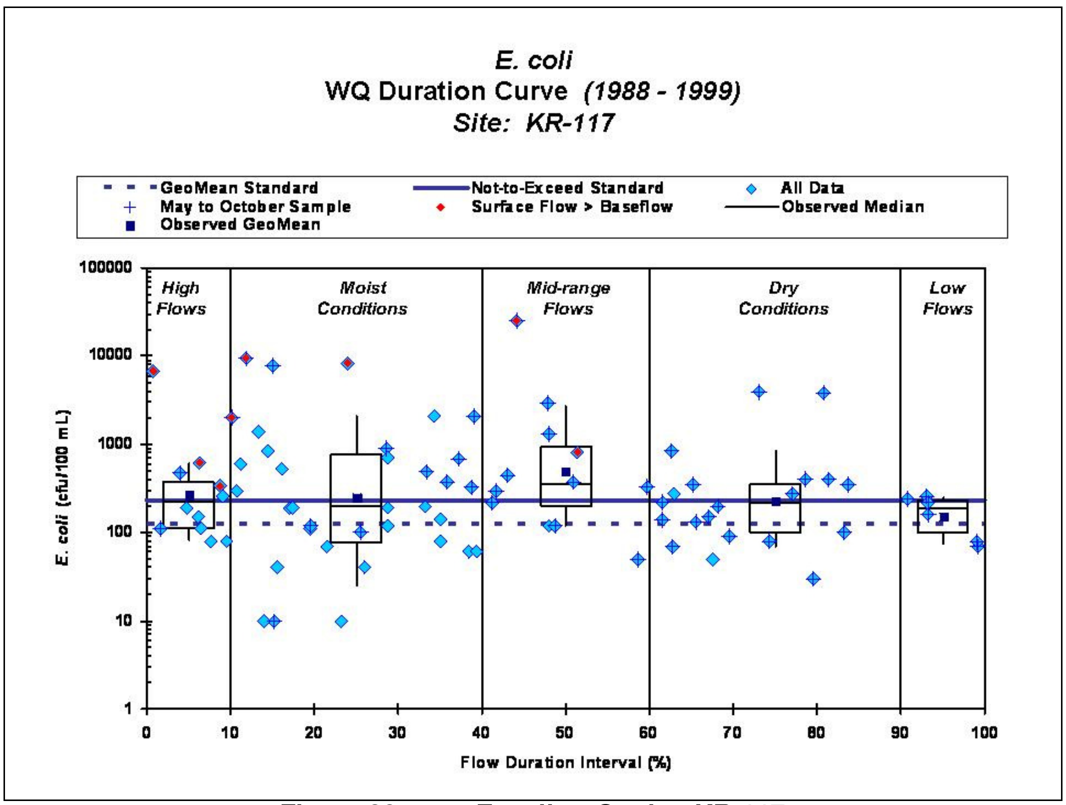



**Figure 28. *E. coli* at Station KR-117**

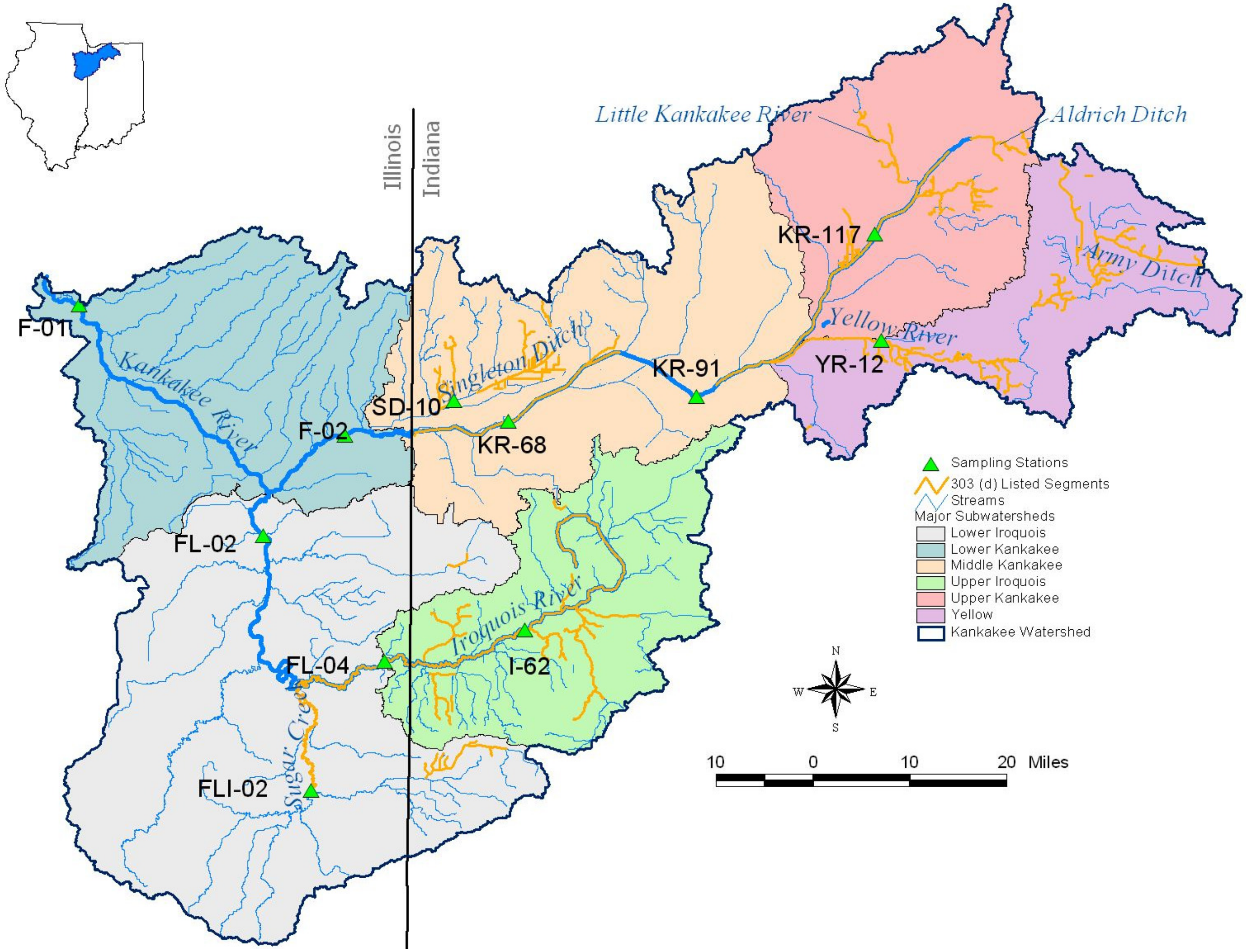



**Figure 29. Key Sampling Stations in Kankakee/Iroquois River Watershed**

## 6.2 Middle Kankakee

Data compiled for the Middle Kankakee in the summer of 2008 indicate that there are *E. coli* exceedances throughout the subwatershed. Only three sites within the subwatershed do not exceed the geomean standard (Pitner Ditch, Station # 07; Cobb Ditch, Station #06; and Brown Ditch, Station #22). Five stations have geomean values over 600 #/100 mL: #31 (Hunsley Ditch), #29 (Slocum Ditch), #27 (Crooked Creek), #18 (Stony Run Ditch), and #20 (Dehaan Ditch). A detailed assessment of the sources known to exist in these tributaries did not reveal any noticeable difference from other tributaries in the Middle Kankakee subwatershed, however.

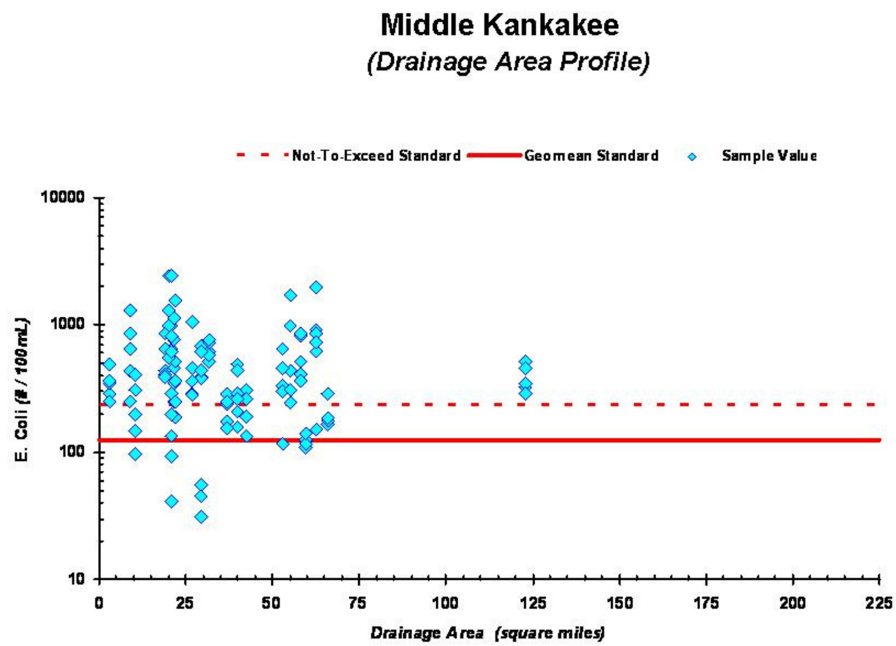
Figure 31 indicates that in general *E. coli* counts are higher in the Middle Kankakee tributaries compared to the mainstem of the Kankakee River. This occurs despite the fact that the Yellow River, which was observed to have very high *E. coli* counts, discharges upstream of the Middle Kankakee. *E. coli* appears to decrease moving downstream due to the larger dilution capacity of the river.

Most facilities in this subwatershed are in compliance in with their flow and bacteria limits; however, the Hebron Municipal WWTP exceeded its permit limit 10 times between 2004 and 2006 (Table 61).

**Table 61. Summary of NPDES facility compliance with design flow and bacteria permit limits in the Middle Kankakee subwatershed (2004 to 2006).**

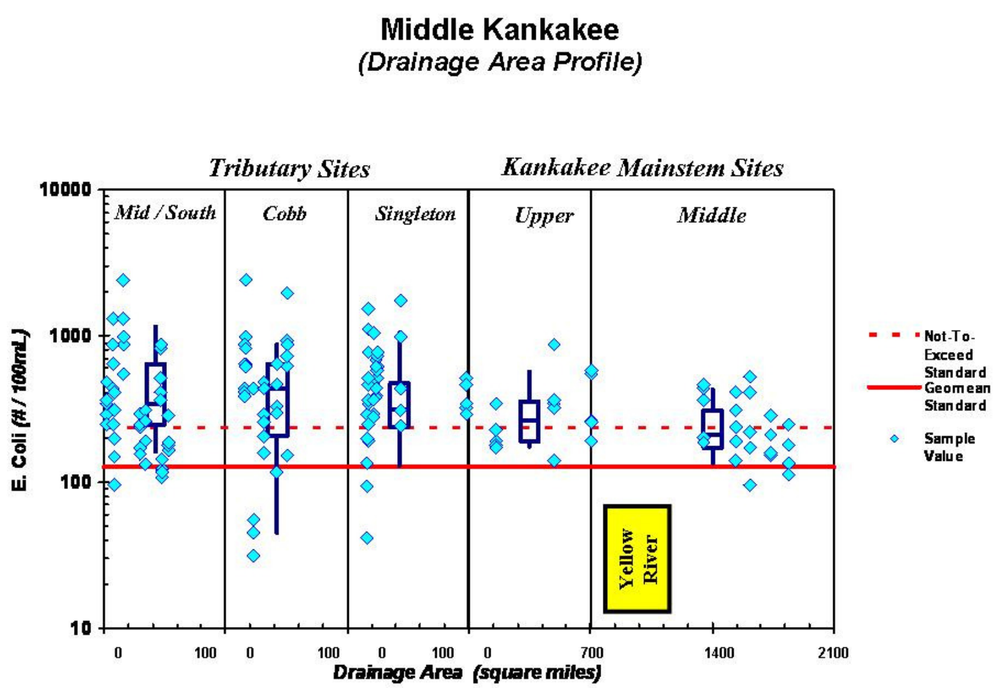
| NPDES ID | Facility Name | Flow | | Bacteria | |
|---|---|---|---|---|---|
| | | Design Flow (MGD) | Number of Violations | Limit (#/100 mL) | Number of Violations |
| IN0020061 | Hebron Municipal WWTP | 0.52 | 9 | 125* | 10 |
| IN0023400 | Kouts Municipal WWTP | 0.33 | 1 | 125* | 1 |
| IN0023621 | Lowell WWTP | 4 | 0 | 125* | 1 |
| IN0030651 | South Haven Sewer Works WWTP | 2 | 5 | 125* | 3 |
| IN0031127 | Winfield Elementary School | 0.01 | 1 | 125 | 4 |
| IN0033081 | Dalecarlia Utilities Lake Dale | 0.044 | 0 | 125* | 1 |
| IN0037176 | Twin Lakes Utilities | 1.1 | 3 | 125* | 4 |
| IN0039101 | Water Services Co Of Indiana | 0.155 | 0 | | 1 |
| IN0040754 | Wheatfield Municipal WWTP | 0.077 | 5 | 125 | 0 |
| IN0042978 | Westville Correctional Center | 0.75 | 1 | 125* | 4 |
| IN0045888 | Boone Grove Elem & Middle School | 0.023 | 1 | 125 | 0 |
| IN0052248 | Morgan Township School | 0.0132 | 6 | 125 | 0 |
| IN0056669 | Wanatah Wastewater Trmt Plant | 0.078 | 14 | 125 | 0 |
| IN0057029 | Boone Grove High School WWTP | 0.01875 | 1 | 125* | 7 |
| IN0061450 | Hebron WWTP | 0.025 | 25 | 125 | 0 |

Notes: MGD = Million gallons per day; ND= No data; *data at this facility also showed exceedances 235 standard




(Data reported by Indiana DEM)

**Figure 30. Middle Kankakee Small Watershed Drainage Area Profile**




(Data reported by Indiana DEM)

**Figure 31. Middle Kankakee Tributary versus Mainstem Drainage Area Profile**

An *E. coli* duration curve was prepared for sampling station KR-68 which is located in the Middle Kankakee subwatershed. Data are available at this station from 1988 to 1999 and the duration curve is shown in Figure 32. The curve indicates that *E. coli* frequently exceeds 235 #/100 mL during high flows. Bacteria sources typically associated with high flows include urban stormwater/CSOs, runoff from agricultural areas, and bacterial re-suspension from the streambed. Most samples during dry conditions and low flows meet water quality standards.

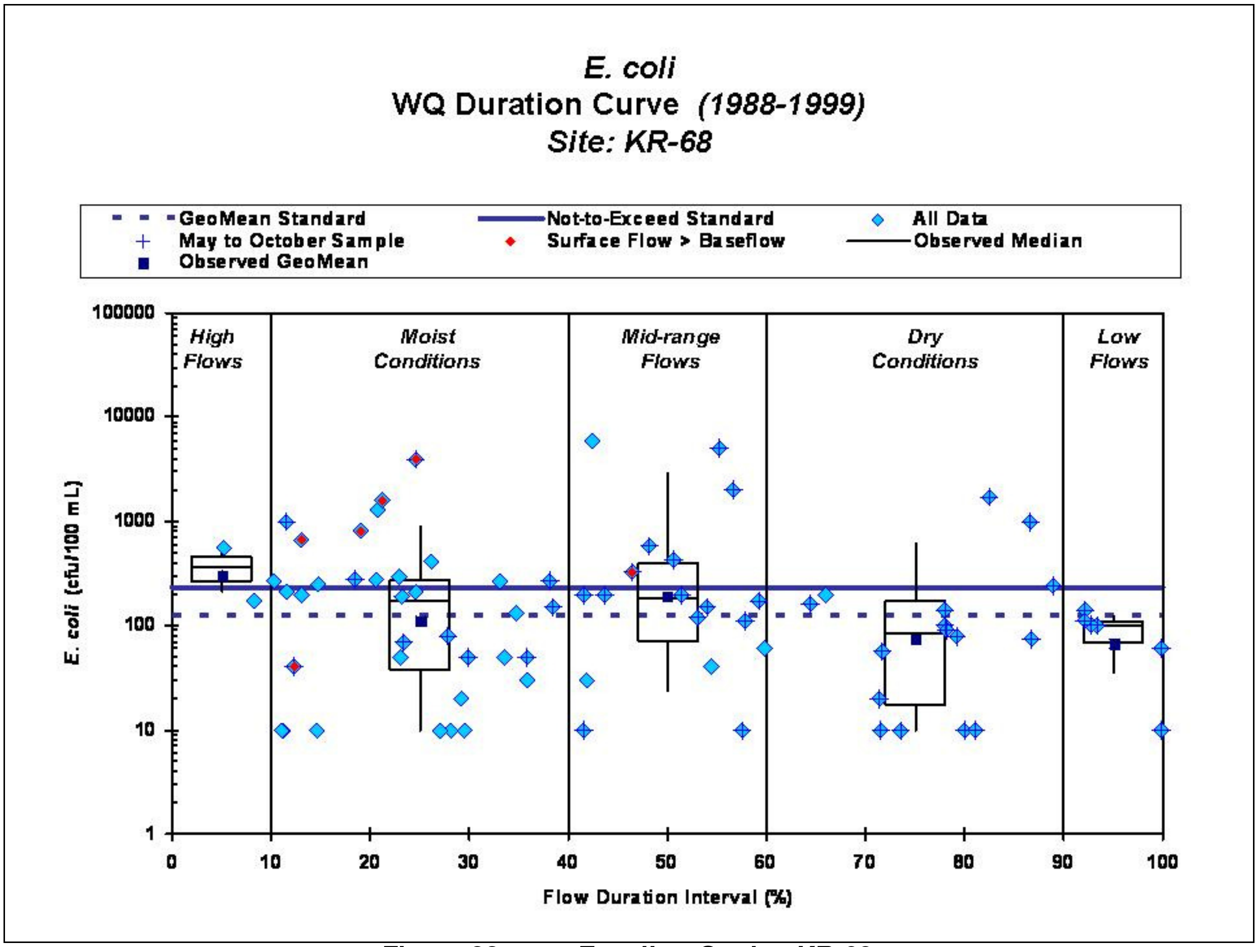



**Figure 32. *E. coli* at Station KR-68**

## 6.3 Yellow River

Data compiled for the Yellow River in the summer of 2008 indicate that it had the worst *E. coli* of any of the subwatersheds. Every site sampled in the subwatershed exceeded the geomean standard of 125 #/100 mL. The site with the lowest geomean was on the main stem Yellow River (Site # 69), with a geomean of 239 counts/100 mL. The tributary within the subwatershed with the lowest geomean was Site #67 of Harry Cool Ditch, with a geomean of 330. A detailed assessment of the sources known to exist in these tributaries did not reveal any noticeable difference from other tributaries in the Yellow River subwatershed, however.

The drainage area profile (Figure 33) suggests a slight increasing trend in the Yellow River as drainage area increases. Tributaries to the Yellow River in general have higher *E. coli* counts than does the middle section of the Yellow River (Figure 34).

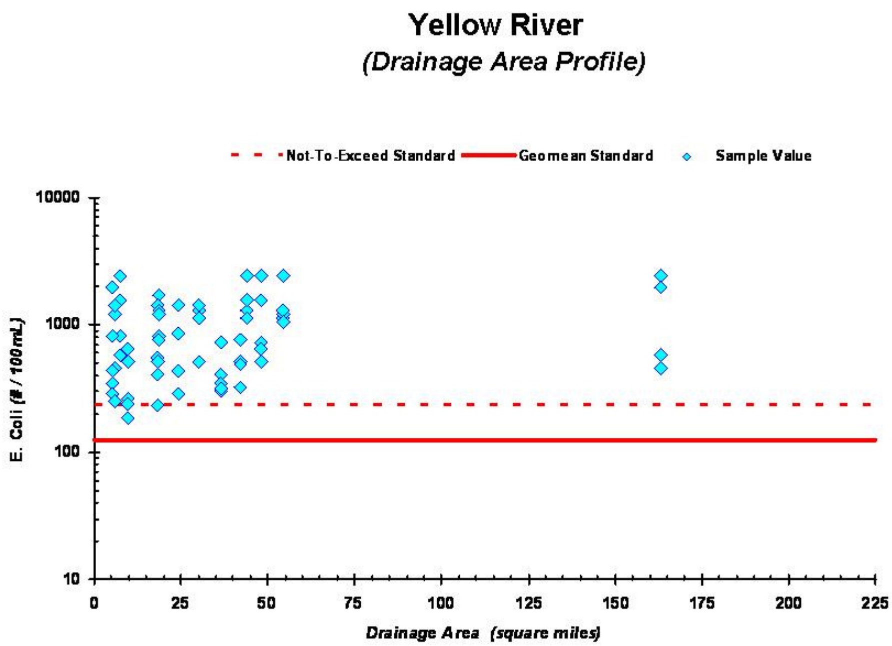
Water quality duration curves were not prepared for any sites in the Yellow River subwatershed because of the lack of historical *E. coli* data.

Most facilities in this subwatershed are in compliance in with their flow and bacteria limits; however, the Knox Municipal WWTP exceeded its permit limit 20 times between 2004 and 2006 (Table 62).

**Table 62. Summary of NPDES facility compliance with design flow and bacteria permit limits in the Yellow River subwatershed (2004 to 2006).**

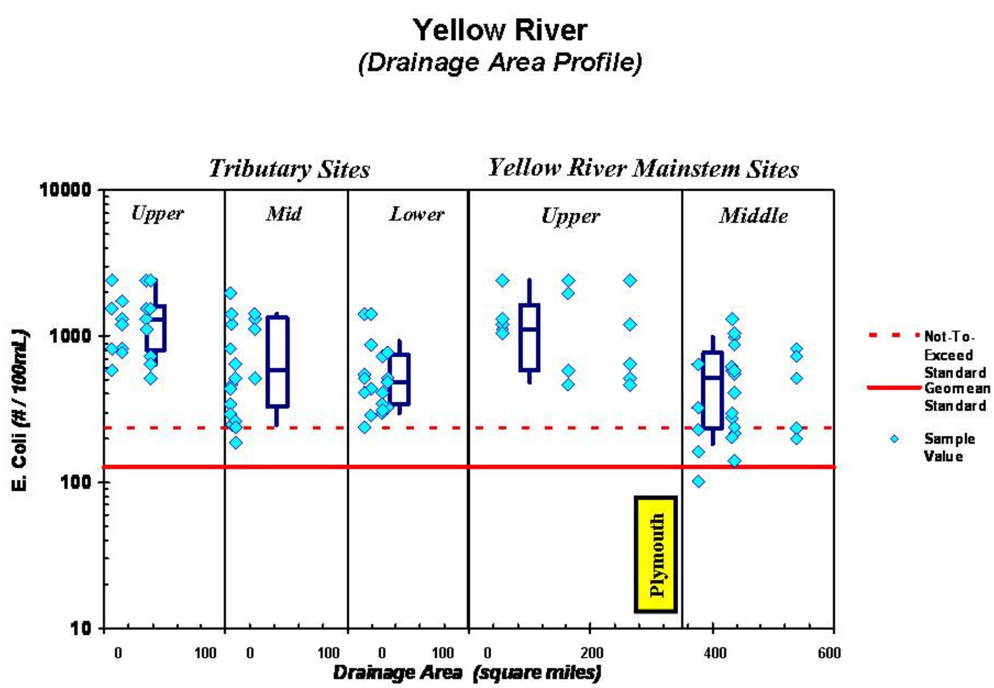
| NPDES ID | Facility Name | Flow | | Bacteria | |
|---|---|---|---|---|---|
| | | Average Design Flow (MGD) | Number of Violations | Limit (#/100 mL) | Number of Violations |
| IN0020427 | Bremen Municipal WWTP | 1.3 | 2 | 125 | No Data |
| IN0020877 | North Judson Municipal WWTP | 0.47 | 8 | 125 | No Data |
| IN0020991 | Plymouth WWTP | 3.5 | 2 | 125 | 0 |
| IN0021385 | Knox Municipal WWTP | 0.7 | 0 | 125* | 20 |
| IN0022284 | Argos Municipal WWTP | 0.212 | 2 | 125 | 0 |
| IN0025160 | Convent Ancilla Dominion | 0.046 | 9 | 125* | 3 |
| IN0040223 | Lapaz Municipal WWTP | 0.126 | 1 | 125 | 0 |
| IN0057002 | Lake Of The Woods RSD | 0.135 | 3 | 125 | No Data |
| IN0058289 | Bass Lake Conservancy District | 0.284 | 1 | 125 | No Data |

Notes: MGD = Million gallons per day; ND= No data; *data at this facility also showed exceedances 235 standard




(Data reported by Indiana DEM)

**Figure 33. Yellow River Small Watershed Drainage Area Profile**




(Data reported by Indiana DEM)

**Figure 34. Yellow River Tributary versus Mainstem Drainage Area Profile**

## 6.4 Upper Iroquois

Data compiled for the Upper Iroquois in the summer of 2008 indicate that there are *E. coli* exceedances throughout the Indiana portion of the subwatershed (limited data are available for the Illinois portion of the watershed). Every site sampled in the subwatershed exceeded the geomean standard of 125 #/100 mL. The site with the lowest geomean was on the main stem Iroquois River (Site # 80). The tributary within the subwatershed with the lowest geomean was Site # 70 on Carpenter Creek. The drainage area profile (Figure 35) does not show any definitive patterns within the subwatershed. Three stations have geomean values over 800 #/100 mL: # 68 (Carpenter Creek), # 76 (Hunter Ditch), and # 84 (Montgomery) but a detailed assessment did not reveal any characteristics unique to these streams.

Similar to other subwatersheds, the tributaries to the Upper Iroquois in general have higher *E. coli* counts than the Upper Iroquois itself (Figure 36).

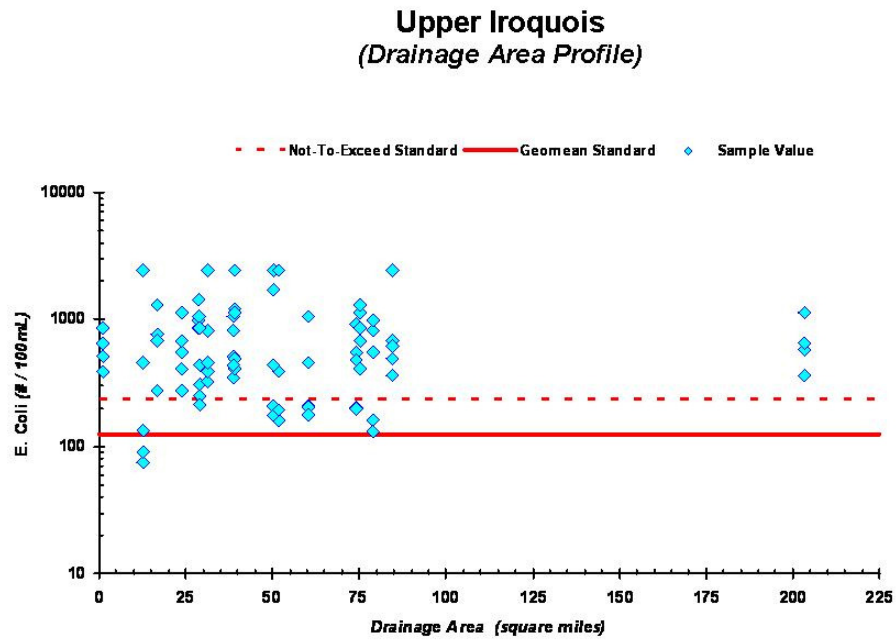
Water quality duration curves were not prepared for any sites in the Upper Iroquois subwatershed because of the lack of historical *E. coli* data.

Most facilities in this subwatershed are in compliance in with their flow and bacteria limits (Table 63).

**Table 63. Summary of NPDES facility compliance with design flow and bacteria permit limits in the Upper Iroquois subwatershed (2004 to 2006).**

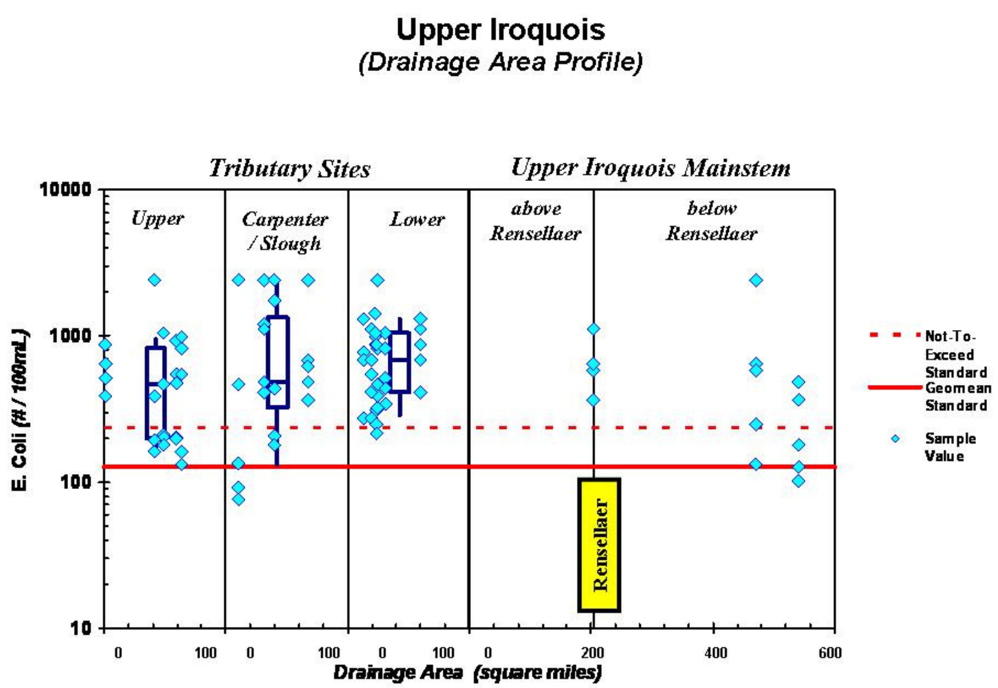
| NPDES ID | Facility Name | Flow | | Bacteria | |
|---|---|---|---|---|---|
| | | Average Design Flow (MGD) | Number of Violations | Limit (#/100 mL) | Number of Violations |
| IN0020940 | Remington WWTP | 0.429 | 5 | 125 | 0 |
| IN0023329 | Kentland Municipal WWTP | 0.46 | 5 | 125* | 4 |
| IN0024414 | Rensselaer Municipal STP | 1.2 | 5 | 125* | 5 |
| IN0039764 | Brook Municipal WWTP | 0.1 | 5 | 125 | No Data |
| IN0040070 | Goodland Municipal WWTP | 0.095 | 8 | 125 | No Data |
| IN0041904 | Trail Tree Inn | 0.256 | 0 | 125* | 1 |
| IN0050997 | George Ade Mem Health Care Ctr | 0.014 | 1 | 125* | 4 |
| IN0053422 | Grandmas Home Cooking | 0.0289 | 0 | 125 | 2 |

Notes: MGD = Million gallons per day;*data at this facility also showed exceedances 235 standard




(Data reported by Indiana DEM)

**Figure 35. Upper Iroquois Small Watershed Drainage Area Profile**




(Data reported by Indiana DEM)

**Figure 36. Upper Iroquois Tributary versus Mainstem Drainage Area Profile**

## 6.5 Lower Iroquois-Indiana

Data compiled for the Lower Iroquois in the summer of 2008 indicate that there are *E. coli* exceedances throughout the Indiana portion of the subwatershed. Every site sampled in the subwatershed exceeded the geomean standard of 125 #/100 mL. The drainage area profile (Figure 37) does not show any definitive patterns within the subwatershed and there are limited data to compare the tributaries to the mainstem (Figure 36).

Water quality duration curves were not prepared for any sites in the Indiana portion of the Lower Iroquois subwatershed because of the lack of historical *E. coli* data.

It is difficult to assess whether facilities in this subwatershed are in compliance in with their bacteria limits due to a lack of data reported in PCS; many have violated their flow limits, however (Table 64).

**Table 64. Summary of NPDES facility compliance with design flow and bacteria permit limits in the Lower Iroquois subwatershed (2004 to 2007).**

| NPDES ID | Facility Name | Exemption Status | Flow | | Bacteria | |
|---|---|---|---|---|---|---|
| | | | Average Design Flow (MGD) | Number of Violations | Limit (#/100 mL) | Number of Violations |
| IL0022161 | Watseka STP | None | 1.6 | 34 | 200 | 39 |
| IL0023272 | Milford STP | Year Round | 0.2 | 33 | 200 | No Data |
| IL0025062 | Gilman-North STP | Year Round | 0.5 | 33 | 200 | No Data |
| IL0042391 | Cissna Park STP | Year Round | 0.1 | 27 | 200 | No Data |
| ILG551007 | Merkle-Knipprath Nursing Home | Year Round | 0.015 | 4 | 200 | No Data |
| ILG551072 | Il Dot-I-57 Iroquois County | Year Round | 0.0162 | 13 | 200 | No Data |
| ILG580122 | Rankin STP | Year Round | 0.08 | 41 | 200 | No Data |
| IN0060798 | Morocco WWTP | None | 0.15 | 1 | 125 | 4 |
| IL0022161 | Watseka STP | None | 1.6 | 34 | 200 | No Data |
| IL0023272 | Milford STP | Year Round | 0.2 | 33 | 200 | No Data |

Notes: MGD = Million gallons per day.

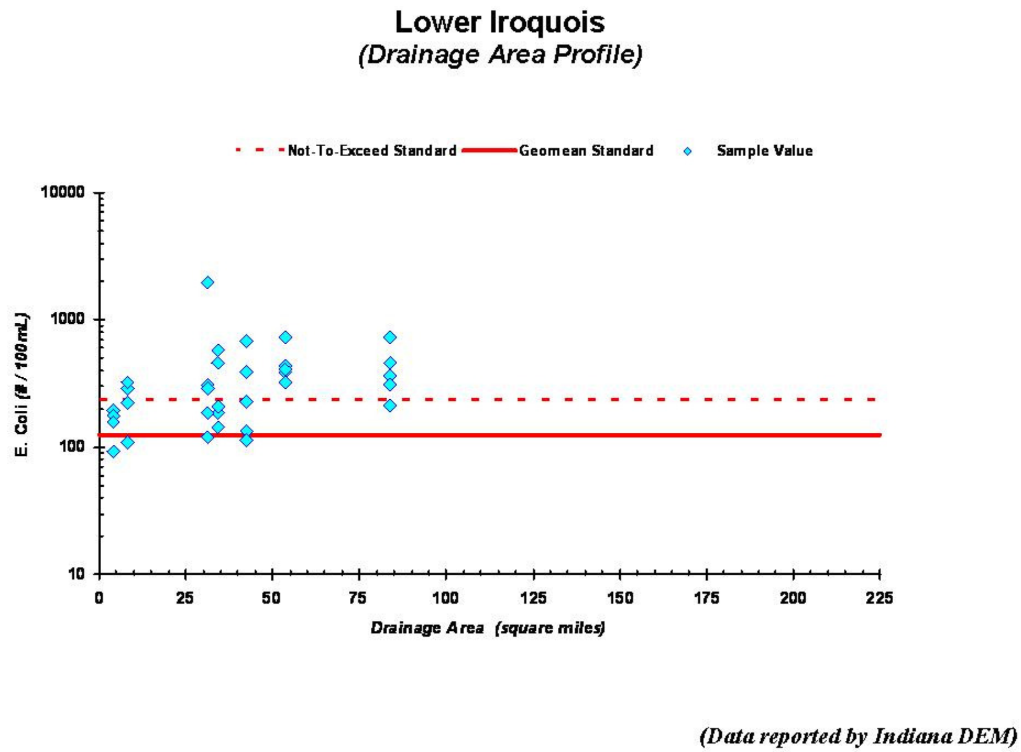



Figure 37. Lower Iroquois Small Watershed Drainage Area Profile

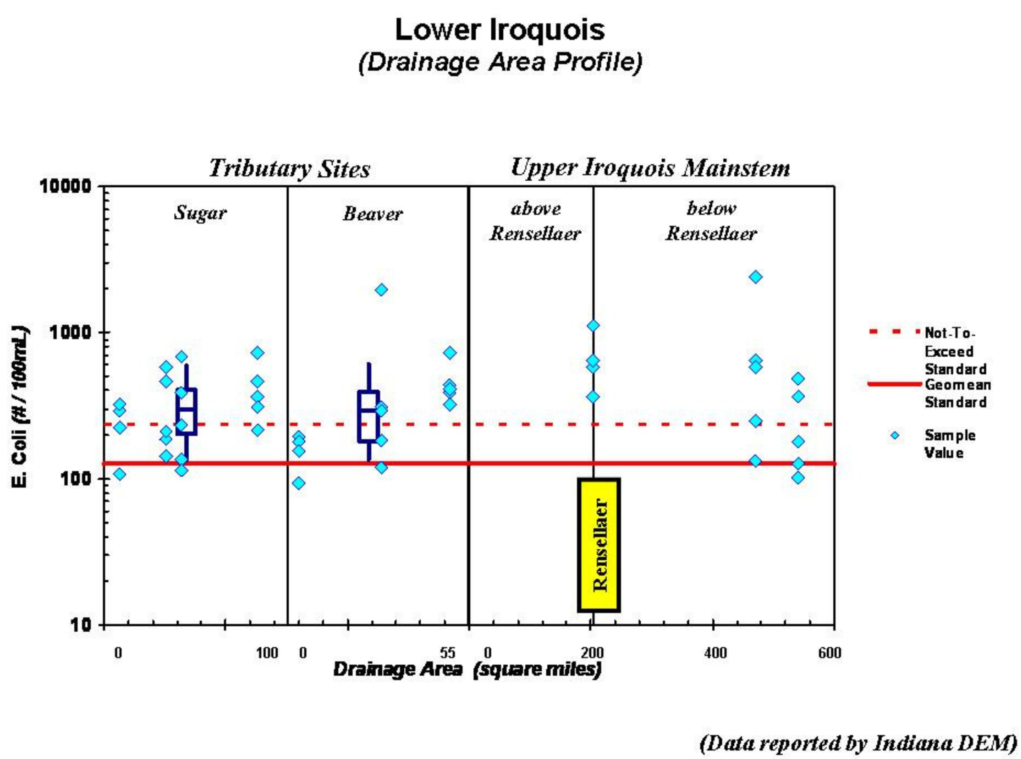



Figure 38. Lower Iroquois Tributary versus Upper Iroquois Mainstem Drainage Area Profile

## 6.6 Lower Iroquois-Illinois

Data collected in the Lower Iroquois in the summer of 2008 indicate that there are fecal coliform bacteria exceedances throughout the Illinois portion of the subwatershed. Seventeen sites sampled in the subwatershed exceeded the geomean standard of 200 #/100 mL.

The drainage area profile (Figure 39) displays a slight decreasing trend in fecal coliform as drainage area increases. Fecal coliform counts collected from the Lower Iroquois itself are somewhat lower than those collected from tributaries to the Lower Iroquois (Figure 40).

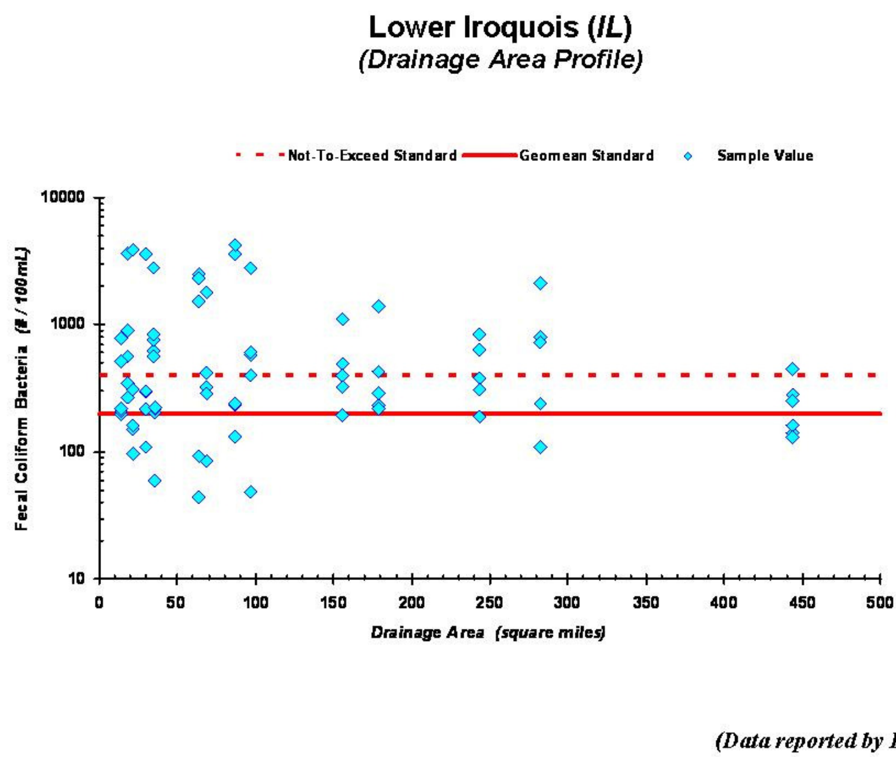



**Figure 39. Lower Iroquois Small Watershed Drainage Area Profile (> 500 square miles)**

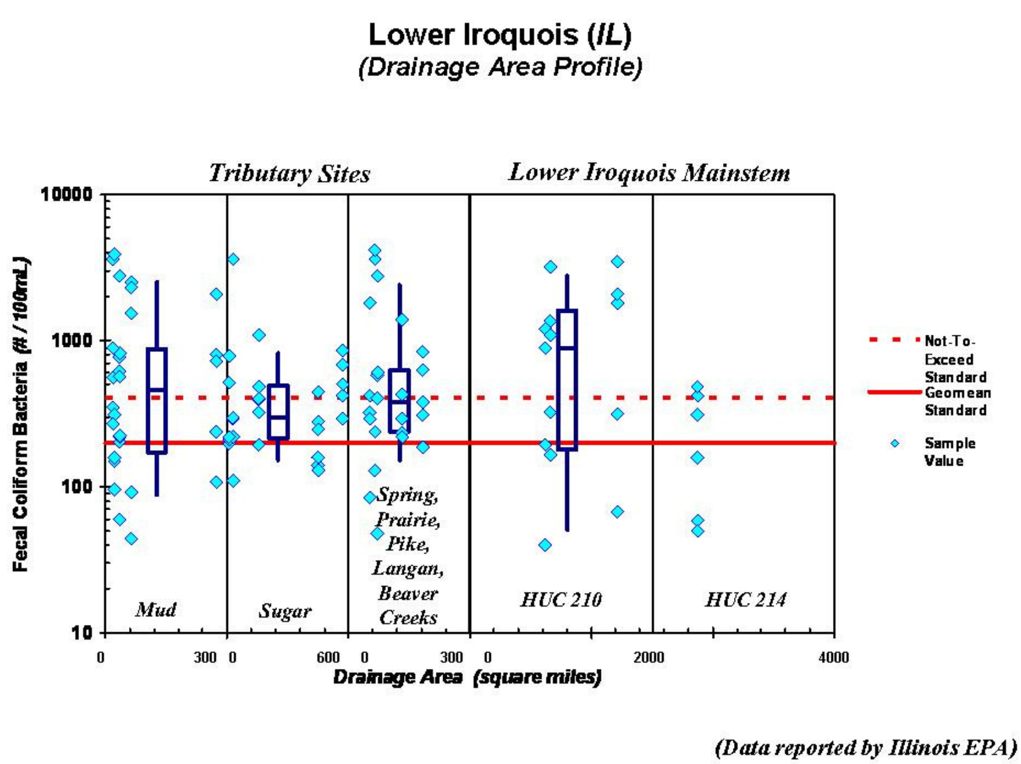



**Figure 40. Lower Iroquois Tributary versus Lower Iroquois Mainstem Drainage Area Profile**

A fecal coliform duration curve was prepared for sampling station FL-04 which is located on the Iroquois River at Iroquois. Data are available at this station from 1978 to 2006 and the duration curve is shown in Figure 41. The curve indicates that fecal coliform frequently exceeds 400 #/100 mL during high flows and moist conditions. Most samples from mid-range, dry, and low flow conditions meet water quality standards. Many storm event samples (indicated by the red diamonds) also exceed 400 #/100 mL, even during mid-range and dry conditions. Bacteria sources typically associated with high flow and storm events include urban stormwater/CSOs, runoff from agricultural areas, and bacterial re-suspension from the streambed.

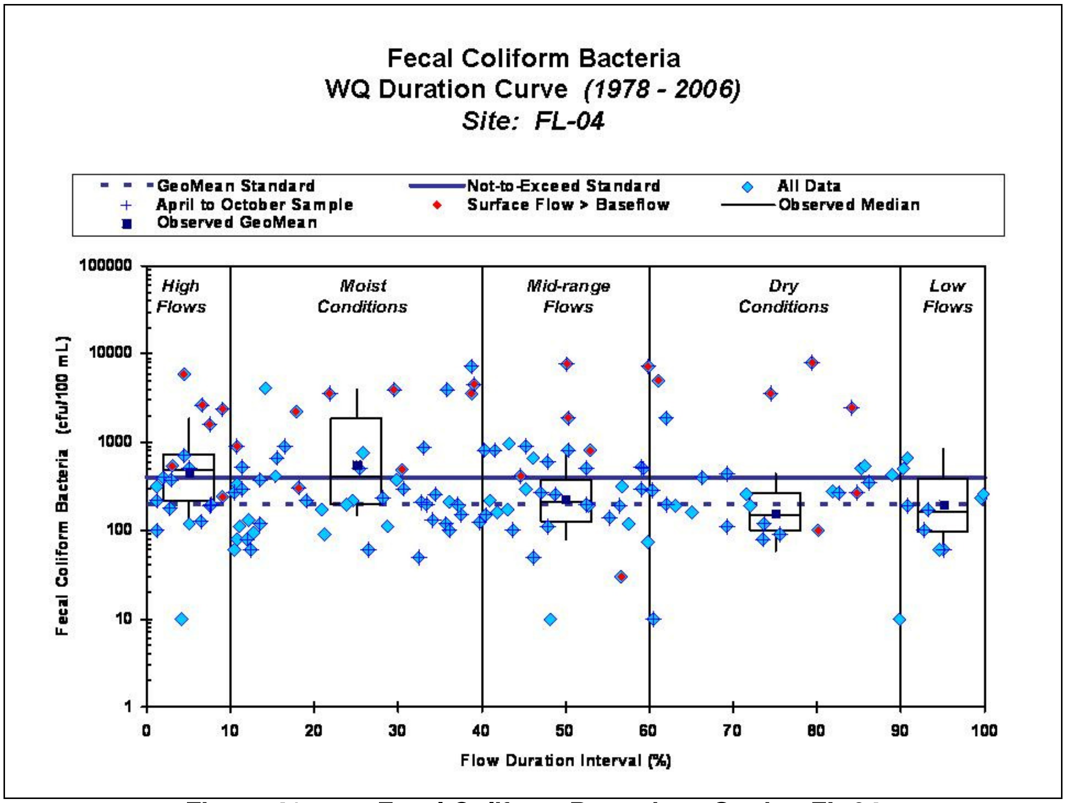



**Figure 41. Fecal Coliform Bacteria at Station FL-04**

A fecal coliform duration curve was also prepared for sampling station FLI-02 which is located on Sugar Creek at Milford in the Lower Iroquois subwatershed. Data are available at this station from 1978 to 2007 and the duration curve is shown in Figure 42. The curve indicates that fecal coliform frequently exceeds 400 #/100 mL during all flow conditions. The fact that fecal coliform is high during low flow conditions suggests that there is a constant source of bacteria to this segment, potentially from a large number of homes on failing or illicitly connected septic systems. Elevated bacteria levels at low flow could also result from inadequate disinfection at wastewater treatment plants

**Sugar Creek in Watseka, Illinois**

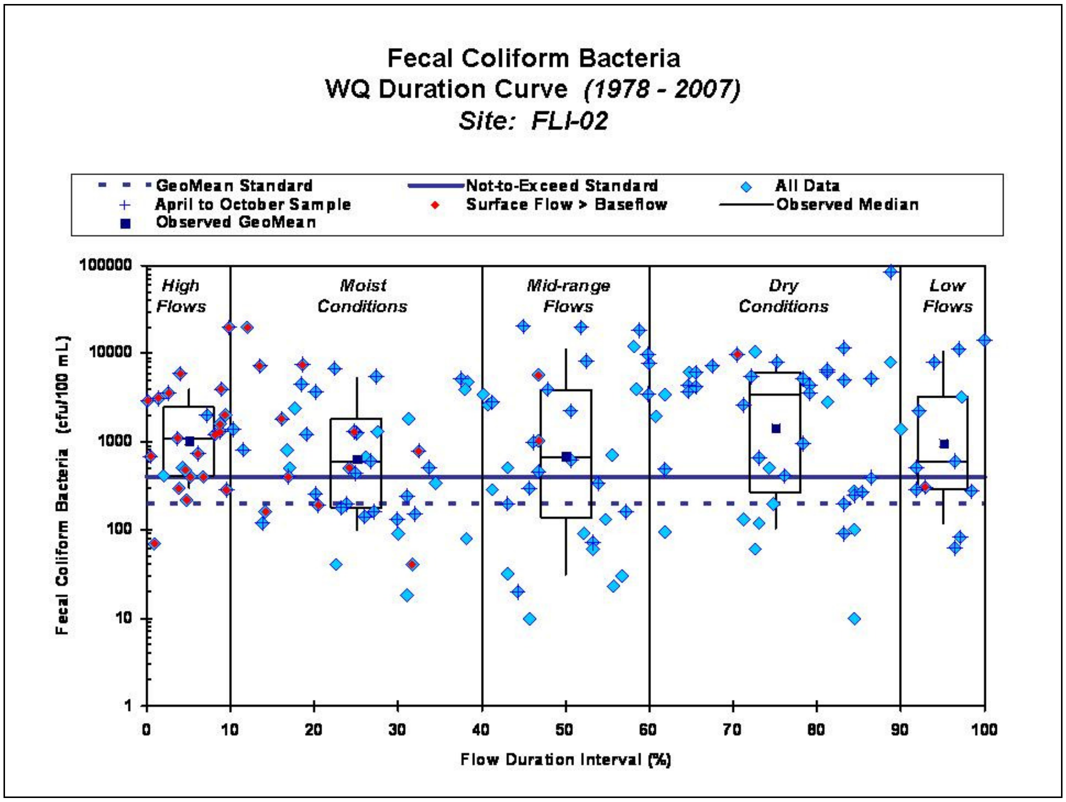



**Figure 42. Fecal Coliform Bacteria at Station FLI-02**

A fecal coliform duration curve was also prepared for sampling station FL-02 located on the Iroquois River near Chebanse. Data are available at this station from 1978 to 2006 and the duration curve is shown in Figure 49. The curve indicates that fecal coliform frequently exceeds 400 #/100 mL during high flows but is usually less than 400 #/100 mL during other flow conditions.

A potential explanation for the higher *E. coli* counts in FLI-02 compared to FL-02 is the difference in drainage area. FL-02 has a much larger drainage area and is located downstream of the Lower Sugar Creek watershed which receives flows from the Upper Iroquois River. *E. coli* counts might therefore be reduced due to the additional dilution afforded by higher flows.

**Iroquois River near Chebanse, Illinois**

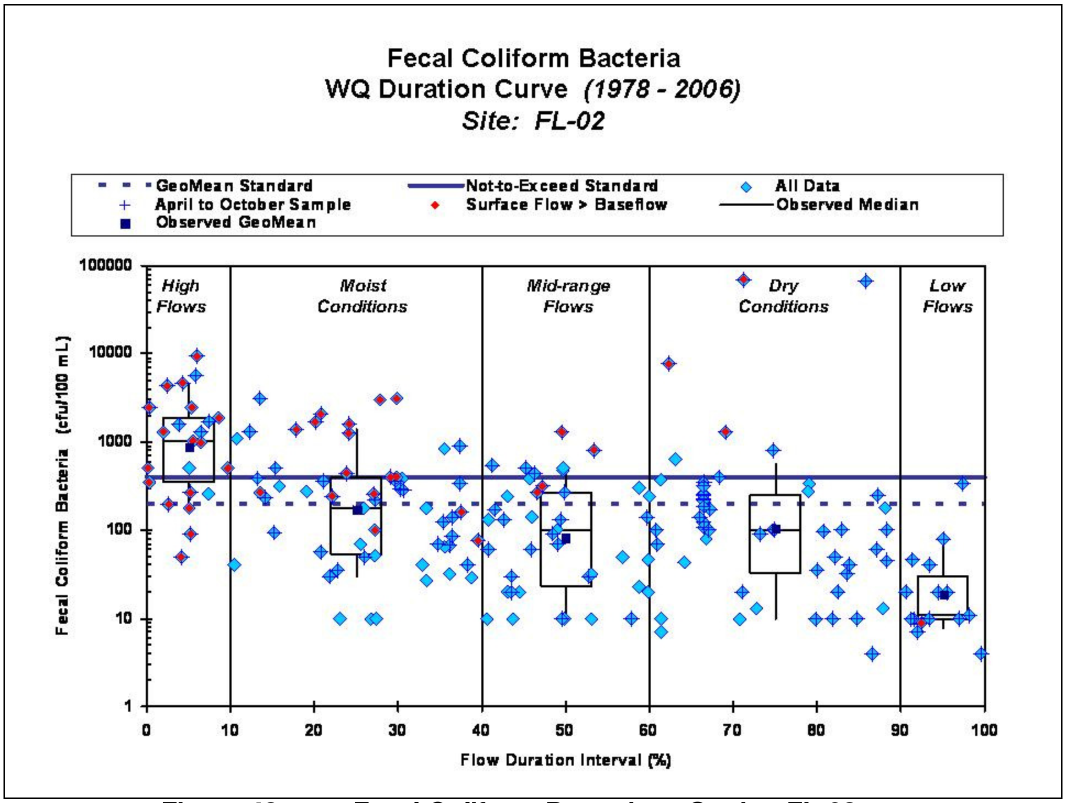



**Figure 43. Fecal Coliform Bacteria at Station FL-02**

## 6.7 Lower Kankakee

Only one station was sampled in the Lower Kankakee in 2008. This was site F-16 on the Kankakee River near Wilmington. The geomean of five fecal coliform samples from this site was only 84 #/100 mL, which is well below the standard. The drainage area at site F-16 is almost 5,000 miles which likely contributes to a great deal of dilution at this location.

Historical data from sites F-02 and F-01 in this subwatershed also suggest that water quality standards are usually met, most likely due to the large drainage area.

**Kankakee River in Momence, Illinois**

It is difficult to assess whether facilities in this subwatershed are in compliance in with their bacteria limits due to a lack of data; many have violated their flow limits, however (Table 65).

**Table 65. Summary of NPDES facility compliance with design flow and bacteria permit limits in the Lower Kankakee subwatershed (2004 to 2007).**

| NPDES ID | Facility Name | Exemption Status | Flow | | Bacteria | |
|---|---|---|---|---|---|---|
| | | | Average Design Flow (MGD) | Number of Violations | Limit (#/100 mL) | Number of Violations |
| IL0021784 | Kankakee River Metro Agency | Seasonal | 25 | 13 | 200* | 17 |
| IL0022179 | Momence STP | Seasonal | 1.6 | 36 | 200* | 3 |
| IL0025089 | Manteno Wpcc | None | 1.15 | 34 | 200 | No Data |
| IL0026085 | Wilmington STP | Seasonal | 0.75 | 6 | 200* | 3 |
| IL0032832 | Herscher STP | Year Round | 0.25 | 23 | 200 | No Data |
| IL0038199 | Manteno Mobile Home Park | Year Round | 0.021 | 28 | 200 | No Data |
| IL0045501 | Sun River Terrace STP | Year Round | 0.075 | 3 | 200* | 15 |
| IL0048968 | Il State Toll Hwy-Plaza 21 STP | None | 0.0005 | 22 | 200 | No Data |
| IL0049522 | Beecher STP | Seasonal | 0.6 | 56 | 200 | No Data |
| IL0050717 | Grant Park STP | Year Round | 0.35 | 17 | 200 | No Data |
| IL0076368 | Essex STP | Year Round | 0.176 | 1 | 200 | No Data |

Notes: MGD = Million gallons per day; *data at this facility also exceeded the maximum criteria of 400 #/100 mL

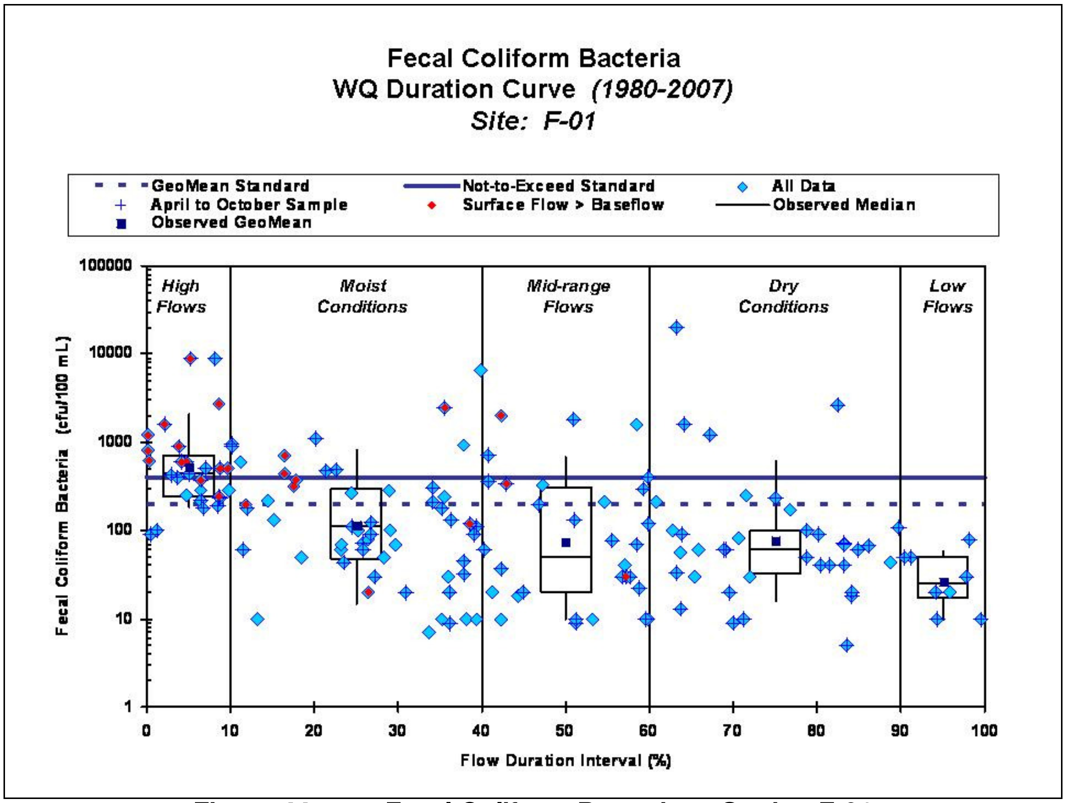



**Figure 44. Fecal Coliform Bacteria at Station F-01**

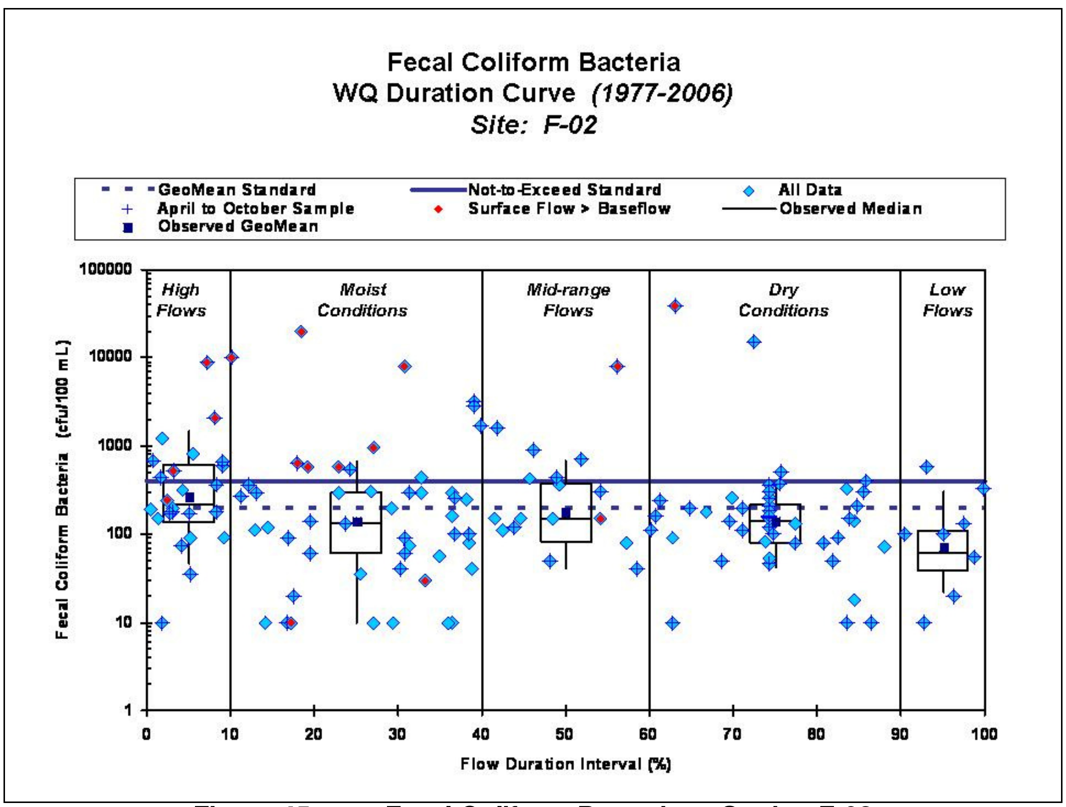



**Figure 45. Fecal Coliform Bacteria at Station F-02**